

*TIMEOUT FROM CONCURRENT SCHEDULES*

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Response-contingent timeouts of equal duration and frequency were added to both alternatives of unequal concurrent schedules of reinforcement. For each of 4 pigeons in Experiment 1, relative response rates generally became less extreme as the frequency of timeout increased. In Experiment 2, relative response rates consistently approached indifference as the duration of timeout was increased. Variation in time allocation was less consistent in both experiments. Absolute response rates did not vary with the timeout contingency in either experiment. In a third experiment, neither measure of choice varied systematically when the duration of a postreinforcement blackout was varied. In contrast to the present results, preference has been shown to vary directly with the parameters of shock delivery in related procedures. The pattern of results in the first two experiments follows that obtained with other manipulations of the overall rate of reinforcement in concurrent schedules. The results of the third experiment suggest that an intertrial interval following reinforcement is not a critical feature of the overall rate of reinforcement.

*Key words:* timeout, concurrent schedules, rate of reinforcement, punishment, key peck, pigeons

Timeout may be defined as a signaled period of extinction. Despite wide application as an aversive event, timeout has a checkered history in the aversive control literature. Leitenberg (1965) reviewed the timeout research and concluded that evidence for the aversiveness of timeout was procedure dependent and that an adequate description of timeout was not available at that time. The picture has not become any clearer; there continue to be a number of puzzling results from procedures involving timeouts (e.g., Nevin, Smith, & Roberts, 1987; Smith, 1981). Much of the recent evidence puts the emphasis on the role of the stimulus correlated with the period of timeout. In a concurrent-chains procedure, Kendall (1974, 1985; cf. Fantino, Dunn, & Meck, 1979) compared alternatives ending in 100% and 50% reinforcement. In some conditions, food after a delay and periods of extinction were signaled by the same terminal-link stimulus on the 50% alternative. Under these conditions nearly exclusive preference for the 100% alternative was obtained; the terminal-link stimulus on the 50% alternative could be described as devalued as

a conditioned reinforcer by the partial correlation with periods of extinction. In other conditions, food after a delay and periods of extinction were signaled by two different stimuli, and the preference for the 100% alternative was substantially lower than expected on the basis of simple matching to the relative percentages of reinforcement. There was no evidence that the signaled periods of extinction (timeouts) punished responding. More recently, Dunn, Williams, and Royalty (1987) added periods of extinction to the initial link of one alternative of concurrent-chains schedules of food delivery. When a terminal-link stimulus was presented during the extinction periods, preference for that terminal link decreased with increases in the frequency of extinction periods. Again, a partial correlation between a terminal-link stimulus and extinction appeared to devalue that stimulus as a conditioned reinforcer. However, when the periods of extinction were uniquely signaled by other than a terminal-link stimulus, the subjects were indifferent between two alternatives. Moreover, there were no systematic differences between conditions with response-contingent and response-independent schedules of timeout. In sum, timeouts did not appear to reduce the relative frequency of contingent choice responses in these procedures. There are comparable results from single chain procedures (e.g., Branch, 1977; Kendall, 1973; Wilton & Clements, 1971).

These results raise the question of timeout

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as a punisher in choice procedures. Other investigations of punishment of behavior maintained on concurrent schedules have varied the parameters of equal schedules of shock superimposed on unequal schedules of reinforcement (de Villiers, 1980; Farley, 1980). Farley varied the frequency of shock presentations, whereas de Villiers varied the intensity of the shocks. Both investigators reported that preference varied directly with the parameters of shock delivery. The more frequent or intense the shock, the more extreme the preference on the concurrent food schedules. In the present research, response-contingent timeouts of equal duration and frequency were added to both alternatives in a choice between unequal schedules of reinforcement.

### EXPERIMENT 1

Farley (1980) varied the frequency of equal schedules of response-contingent shock added to concurrent schedules of reinforcement. Preference for the schedule providing more frequent reinforcement increased with the frequency of shock deliveries. Experiment 1 used a similar procedure to assess the effect of added schedules of timeout from reinforcement. Results from several recent studies suggest that the timeout schedules may produce an opposite pattern of results. Alsop and Davison (1988), Alsop and Elliffe (1988), Davison (1988), and Logue and Chavarro (1987) have all demonstrated reduced sensitivity to the parameters of reinforcement with decreases in the overall rate of reinforcement on concurrent schedules (cf. Fantino, Squires, Delbrück, & Peterson, 1972). Of particular relevance to Experiment 1, Alsop and Elliffe (1988) and Logue and Chavarro (1987) reported a trend toward indifference between two frequencies of reinforcement as the overall rate of reinforcement decreased. In Experiment 1, the variation in the frequency of timeout entailed concomitant variation in the overall rate of reinforcement. Thus, if response-contingent timeout punishes responding on concurrent schedules, preference for the richer schedule of reinforcement would be expected to increase with the frequency of timeouts. If timeout is not a punisher in this context, preference may be expected to decrease with increases in the frequency of timeouts.

### METHOD

#### *Subjects*

Four adult male White King pigeons with various experimental histories were maintained at approximately 80% of their free-feeding weights. The birds were weighed after each experimental session and fed appropriate amounts of mixed grain. Water and grit were available in the home cages.

#### *Apparatus*

The experimental chambers for Birds R71 and R72 were cubes, 35.5 cm on a side. There were three translucent response keys and a hopper on the aluminum front panel. The keys were 2.5 cm in diameter and evenly separated at 25.5 cm above the grid floor. The hopper opening was located 9.5 cm beneath the center key. The back panel was aluminum. The remaining sides and ceiling were plywood. The chambers were housed in double-walled wooden enclosures.

The chambers used for Birds R55 and R56 were cylindrical, 36 cm in height and 33 cm in diameter. Three response keys were 2.5 cm in diameter and mounted 24 cm above the grid floor. The hopper opening was 26 cm below the center key.

In both sets of chambers, the response keys could be transilluminated with various colors. A minimum force of approximately 0.16 N was required for key operation. A 50-ms blackout on all keys provided feedback for responses on operative lighted keys. When activated, the solenoid-operated hopper was illuminated by white light and allowed 4-s access to mixed grain. A houselight mounted above the keys provided general chamber illumination except during operation of the hopper. White noise was present continuously. Scheduling of experimental events and data recording were maintained by a PDP 8E® computer.

#### *Procedure*

Concurrent variable-interval (VI) 90-s and VI 45-s schedules of food delivery were programmed on the left and right keys, respectively. Only one side key was illuminated and operable at a time. Changeover to the other key was produced by four successive pecks to the center key. A response to the lighted side key during the completion of the changeover

Table 1

The schedules of timeout (TO) in the order of presentation and the results of Experiment 1.

Subject	Schedule of TO (s)	Responses/min		Time (s)		Relative rft. rate on right	Relative TO rate on right	Changeovers/min	Sessions to stability
		Left	Right	Left	Right				
R55	VI 90	9.1	13.7	907	604	.63	.51	13.8	42
	VI 45	10.2	11.5	938	625	.64	.49	10.8	46
	VI 90	7.3	11.3	798	680	.68	.51	10.8	21
	None	8.0	20.5	606	949	.71	—	9.6	32
	VI 180	9.2	11.2	782	723	.64	.55	15.6	27
R56	VI 90	9.9	20.1	633	874	.65	.48	13.2	41
	VI 45	10.6	18.8	599	898	.70	.50	15.0	35
	VI 180	9.2	17.8	645	891	.64	.46	16.8	28
	None	7.2	18.6	555	944	.64	—	12.0	20
	VI 90	9.9	13.2	731	792	.67	.47	16.8	21
R71	VI 45	14.4	19.2	574	862	.68	.50	14.4	31
	VI 90	12.2	23.8	551	937	.67	.51	12.0	51
	VI 180	10.4	18.4	687	875	.67	.47	13.8	32
	None	8.9	21.7	574	978	.66	—	12.0	23
	VI 45	10.0	19.4	554	944	.67	.54	11.4	49
R72	VI 45	21.4	43.4	678	865	.64	.48	23.4	24
	VI 90	22.1	66.2	547	931	.69	.49	18.0	34
	VI 180	19.5	95.1	395	1,068	.64	.53	15.0	34
	VI 45	28.4	106.6	535	950	.68	.51	12.3	27
	None	15.8	96.8	403	1,088	.70	—	16.2	29

ratio reset the requirement to four responses. The measure of time allocation included time on an alternative until the changeover ratio was completed. The left and right side key colors were red and blue, respectively. The center key was illuminated with a horizontal white bar on a dark background. In some conditions, responses to either side key also produced 20-s timeouts on equal concurrent VI schedules. During timeout, all VI timers (food and timeout) were stopped, the center key was dark (no changeovers were possible), and the side key was either green (left) or white (right). The side key not associated with the timeout was dark. There was no programmed feedback for responses on the lighted key during timeout. Timeout and food delivery were always separated by a minimum of 1.5 s. The VI schedules were derived from the distribution suggested by Fleshler and Hoffman (1962). Following food delivery, the operative side key was randomly selected. The frequency of timeouts on each alternative was varied from an average of one per 45 s on each key to zero timeouts per session. The first condition for each subject was repeated once during the sequence. The timeout schedule values are given in Table 1 in the order of presentation for each

subject. Each condition continued for a minimum of 20 sessions and until the following stability criteria had been satisfied. After 20 sessions, the relative rates of responding on the two side keys in the previous nine sessions were divided into blocks of three sessions. Performance was considered stable when the means of the three blocks neither differed by more than 0.05 nor exhibited a trend, that is, neither  $M_1 > M_2 > M_3$  nor  $M_3 > M_2 > M_1$ . The numbers of sessions in each condition are presented in Table 1. In all conditions, daily sessions continued for 48 food presentations.

## RESULTS

The data were averaged over the last nine sessions of each condition. Relative response rates and time allocations are plotted as a function of timeout frequency in Figure 1. In general, the proportion of responses on the VI 45-s key decreased (became less extreme) as the frequency of timeouts increased. When there were no timeouts, relative rates of responding exceeded the relative rate of reinforcement. For Birds R56 and R71, the proportion of time spent on the VI 45-s key remained roughly constant across conditions. For R55 and R72, the proportion of time spent

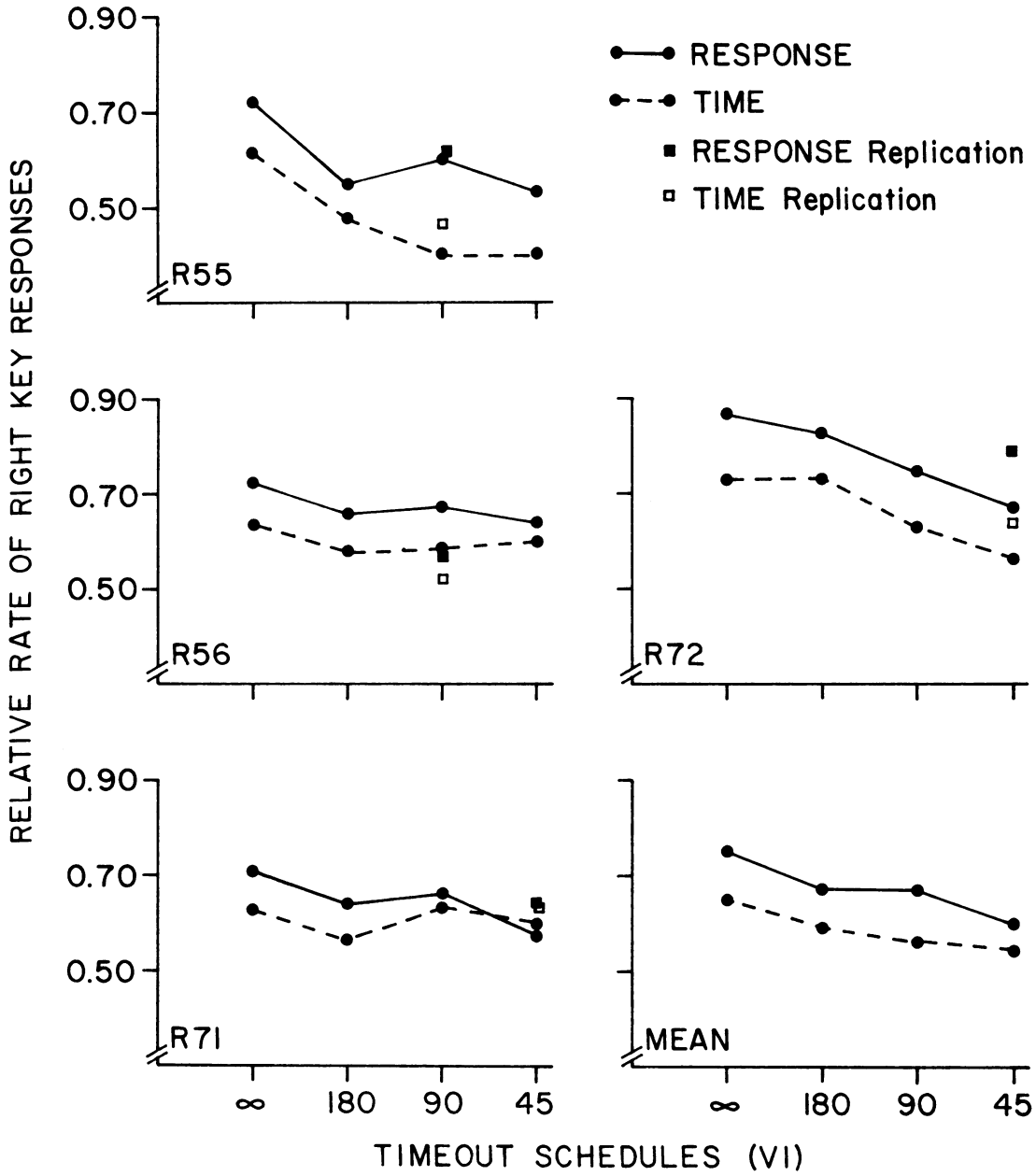


Fig. 1. Relative response rates and time allocation on the VI 45-s alternative (the right key) as a function of the timeout schedule values in Experiment 1. For clarity of presentation, the data points are connected across the ordinal scale on the x axis.

on the VI 45-s key tended to decrease as the frequency of timeouts increased. For all subjects, time allocation was most extreme in the condition with no timeouts. Both measures of choice in the replication of the first condition of each sequence (the filled and unfilled squares in Figure 1) approximated the earlier deter-

minations for R55 and R71 and differed substantially for R56 and R72. The absolute response rates and the time spent in the presence of each lighted side key (excluding timeouts) are presented in Table 1. Absolute response rates did not vary systematically with timeout frequency. The obtained relative reinforce-

ment and timeout rates (also shown in Table 1) closely approximated the programmed proportions in each condition. There were few (never more than 20 per session) or no responses during timeout. The center-key response rate during changeover was recorded occasionally and averaged 135 per minute with little variance. Changeovers were interrupted very rarely by pauses or side-key responses. The rate of changeover in each condition is presented in Table 1.

### DISCUSSION

The relative rates of responding on the VI 45-s schedule varied inversely with timeout frequency for all birds. These results are contrary to those obtained from a comparable procedure in which the frequency of shock was varied (Farley, 1980). A preliminary comparison corresponding to de Villiers' (1980) manipulation of shock intensity can be drawn between the condition with no timeouts (analogous to a zero shock intensity) and the three conditions with 20-s timeouts. Both measures of choice were consistently lower in the conditions with timeouts. Again this pattern of results is inconsistent with the increased preference correlated with the shock contingency. Timeout does not appear to be comparable to shock in this context. The pattern of results does follow that obtained with other manipulations of the overall rate of reinforcement. Both Alsop and Elliffe (1988) and Logue and Chavarro (1987) reported a small decrement in the sensitivity to the relative frequency of reinforcement within the range of the overall rate of reinforcement explored here (0.67 to 2.67 reinforcers per minute).

Two aspects of these data are likely to be dependent on the particulars of the procedure. In the condition with no timeouts, relative response rates overmatched the relative rates of reinforcement. This is consistent with other uses of the fixed-ratio changeover requirement (e.g., Dunn, 1982; Pliskoff & Fetterman, 1981). Second, the time proportions were less extreme than the relative response rates in 15 of 16 possible comparisons (Figure 1). This difference is particularly evident in the data of R55 with time proportions less than .50 in three of four conditions. The record of time allocation included time spent in changeovers and therefore could be expected to be less extreme than the response measure.

### EXPERIMENT 2

The results of Experiment 1 challenge a description of timeout from concurrent schedules of reinforcement as a punisher. In Experiment 2, the duration, rather than the frequency, of timeout was varied. If the duration of the timeout is analogous to the intensity of shock, relative response rates on the schedules of reinforcement would be expected to become more extreme with longer timeout durations (cf. de Villiers, 1980). Again, the results of Alsop and Elliffe (1988) and Logue and Chavarro (1987) provide an opposing prediction: If timeouts of the durations explored here do not punish responding, the attendant variance in the overall rate of reinforcement may influence the sensitivity to the frequency of reinforcement. Preference would be expected to decrease with increases in timeout duration.

### METHOD

#### *Subjects and Apparatus*

Four adult male White King pigeons with various experimental histories were maintained as in Experiment 1.

The experimental chambers for all subjects were identical to the cylindrical chambers used for R55 and R56 in Experiment 1.

#### *Procedure*

Except for the frequency and duration of timeouts, the procedure was identical to that of Experiment 1. Timeouts occurred on a VI 60-s schedule on each side key. The duration of timeout was varied from 0 to 40 s and was equal on the two schedules. The sequence of conditions for each subject is presented in Table 2.

### RESULTS

The data were averaged over the last nine sessions of each condition. Relative response rates and time allocation on the concurrent food schedules are plotted as a function of timeout duration in Figure 2. The proportion of responses on the VI 45-s key decreased consistently as the duration of timeout increased. At both the 0- and 10-s timeout durations, relative rates of responding exceeded the relative rate of reinforcement. In general, time proportions were less extreme than the response measure. For Birds R73, R74, and R75, time proportions in the 40-s timeout condition

Table 2  
Timeout durations in the order of presentation and the results of Experiment 2.

Subject	Duration of TO (s)	Responses/min		Time (s)		Relative rft. rate on right	Relative TO rate on right	Changeovers/min	Sessions to stability
		Left	Right	Left	Right				
R73	10	9.6	19.8	678	889	.66	.52	13.2	31
	40	10.2	17.4	696	725	.62	.51	15.6	38
	10	9.5	22.3	602	904	.67	.48	14.4	31
	0	8.3	24.8	588	1,002	.63	—	10.2	30
R74	0	6.5	22.9	490	1,091	.66	—	10.3	41
	40	8.3	23.5	465	988	.69	.51	8.4	34
	10	7.9	25.1	436	1,066	.71	.53	8.4	26
	0	7.0	24.8	466	1,087	.70	—	15.0	27
R75	40	14.9	30.2	591	964	.63	.51	14.4	31
	10	13.7	41.0	386	1,099	.68	.53	7.8	25
	40	19.1	35.5	655	869	.63	.53	15.0	35
	0	12.9	45.9	469	1,094	.68	—	11.4	25
R76	40	15.8	32.2	515	999	.67	.47	9.0	57
	0	8.4	33.6	510	990	.70	—	16.8	39
	40	17.9	37.9	597	895	.69	.48	13.2	26
	10	16.2	37.8	596	933	.65	.52	17.4	28

were at least slightly lower than in the conditions with no timeouts. However, the trend was not consistent across the three conditions. With the exception of time allocation for R76, both measures of choice in the replication of the first condition in each sequence (the filled and unfilled squares in Figure 2) approximated the earlier determinations. The absolute response rates and time spent in the presence of each lighted side key (excluding timeouts) are presented in Table 2. Again, the total number of key pecks per minute did not vary with the timeout contingency. The obtained relative reinforcement and timeout rates (Table 2) did not vary substantially from the programmed values. There was little or no responding during timeout. The center-key response rate during changeover was recorded occasionally and the averages varied from 106 per minute (R75) to 148 per minute (R73). After the first condition, no interruptions in the changeover ratio were observed. The rate of changeover in each condition is presented in Table 2.

#### DISCUSSION

Relative response rates varied inversely with the duration of the timeout periods. Relative time allocation and absolute response rates neither decreased consistently with the addition of the timeout contingency nor varied systematically with timeout duration. Again, this pattern of results is inconsistent with the results

of a similar procedure investigating shock intensity as the independent variable (de Villiers, 1980). The duration of timeout from concurrent schedules of reinforcement does not appear to be analogous to the intensity of shock.

The pattern of the response measure corresponds to the results obtained in the other manipulations of overall reinforcer frequency. Time allocation did not vary, in accordance with the pattern reported by Alsop and Elliffe (1988). Logue and Chavarro (1987) did not report a time measure.

#### EXPERIMENT 3

One distinction between the timeout procedures in this study and other procedures that vary overall reinforcement rate in concurrent schedules is that, in both experiments reported here, the variance in the overall rate of reinforcement is due entirely to variance in the total duration of signaled periods of extinction; the rate of reinforcement in the presence of the stimuli (specific side-key colors) correlated with the schedules of reinforcement did not vary. In the other choice procedures (Alsop & Elliffe, 1988; Logue & Chavarro, 1987), the overall rate of reinforcement was manipulated by varying the values of the reinforcement schedules. Thus, preference on concurrent schedules appears to be determined in part by overall reinforcement rate whether or not the

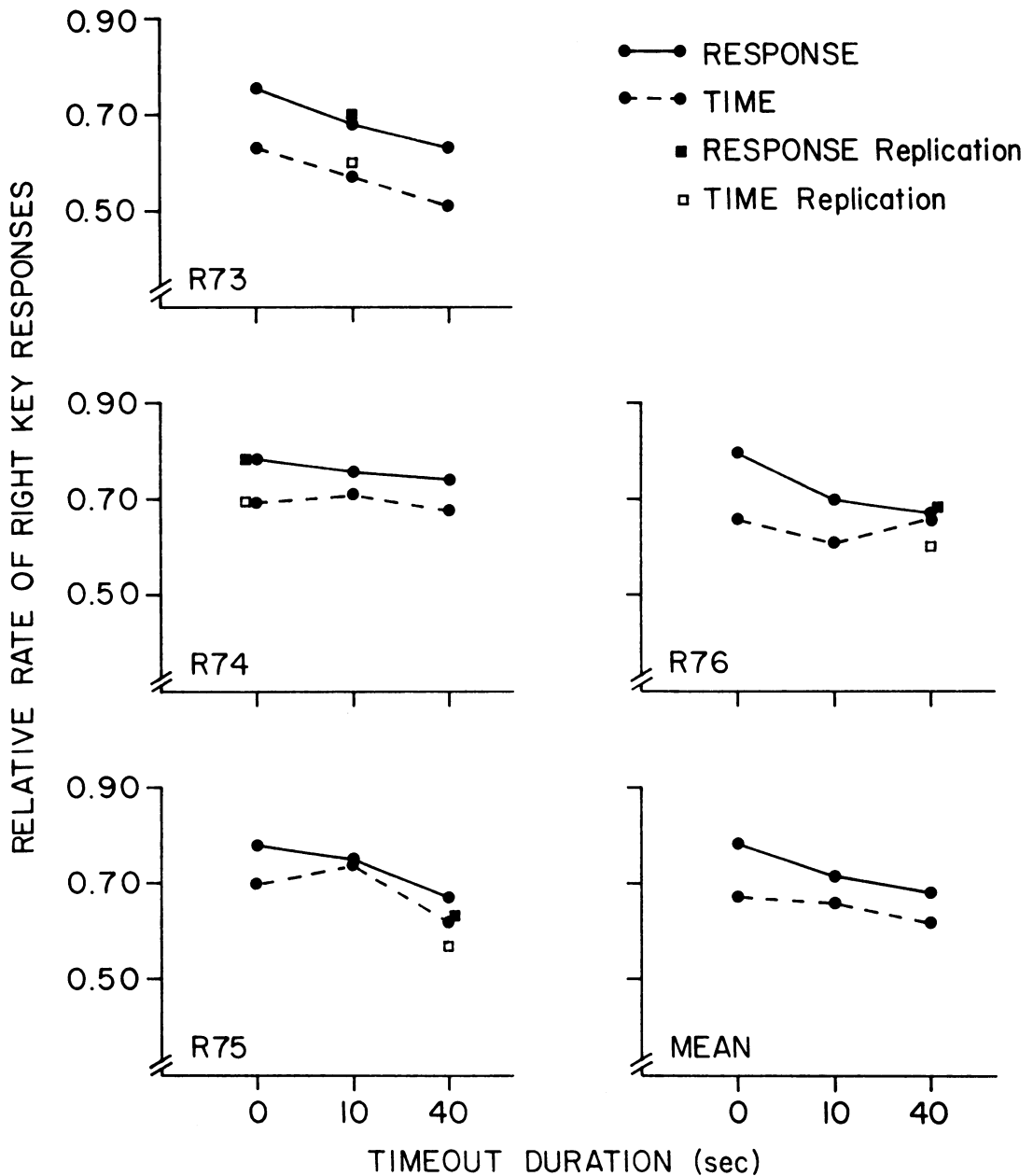


Fig. 2. Relative response rates and time allocation on the VI 45-s alternative (the right key) as a function of timeout duration in Experiment 2. For clarity of presentation, the data points are connected across the ordinal scale on the x axis.

interreinforcement interval includes signaled periods of extinction.

There are alternative procedures for the manipulation of signaled periods of extinction in concurrent schedules that may add to this description. In a close parallel to the procedures

used here, timeout frequency or duration could be varied on response-independent schedules with parameters that otherwise match those in Experiments 1 and 2. This procedure would preserve what may be a critical feature of the prior demonstrations: The timeouts would be

Table 3  
ITI durations in the order of presentation and the results of Experiment 3.

Subject	Duration of ITI (s)	Responses/min		Time (s)		Relative rft. rate on right	Change-overs/min	Sessions to stability
		Left	Right	Left	Right			
R51	10	14.0	56.2	463	1,030	.66	8.4	51
	40	12.1	68.3	465	1,034	.65	6.0	36
	0	13.8	43.8	503	1,021	.66	10.8	24
	40	10.8	79.2	511	991	.67	6.6	20
R52	10	12.0	34.2	570	971	.67	11.4	38
	40	15.0	21.6	645	855	.64	12.0	23
	10	18.0	27.0	530	863	.68	10.8	26
	0	17.5	38.9	584	952	.60	15.0	24
R53	40	20.6	41.8	625	796	.68	22.2	37
	10	17.0	45.9	555	945	.67	11.4	30
	40	12.6	71.4	409	1,000	.68	16.2	35
	0	10.8	40.8	545	890	.67	14.4	24
R54	40	6.7	17.3	498	1,012	.68	7.2	31
	10	5.3	24.1	525	934	.68	11.4	24
	40	7.2	9.6	645	929	.65	10.2	33
	0	10.5	19.5	620	892	.70	16.2	21

presented within the context of (i.e., unpredictably interrupt) the reinforcement schedules. As noted above, Dunn et al. (1987) reported no differences between response-dependent and response-independent schedules of timeout. The drawback to response-independent schedules is that, with responding maintained by a schedule of reinforcement, there is no unobtrusive means of avoiding adventitious response-timeout pairings. Imposition of a negative contingency between the response and timeout would alter the distribution of timeouts.

Another alternative, explored in Experiment 3, is the manipulation of the interval between reinforcement and the onset of the operative side key, that is, an intertrial interval (ITI). Variation in the duration of the ITI would alter the overall rate of reinforcement without changing the rate of reinforcement in the presence of the stimuli correlated with the concurrent schedules of reinforcement as in Experiments 1 and 2. However, in this procedure, the periods of extinction would not occur in the context of the schedules of reinforcement. In Experiment 3, the duration of a period of extinction following food delivery was varied. If the relevant rate of reinforcement is the average over both the periods of extinction and the periods of reinforcer availability, then preference would be expected to

decrease with increases in the duration of the ITI that predictably follows reinforcement. On the other hand, if the contribution of timeout to the overall rate of reinforcement, as observed in the first two experiments, depends on unpredictable interruptions of the schedules of reinforcement, preference would not be expected to vary with the duration of the ITI.

## METHOD

### *Subjects and Apparatus*

Four adult male White King pigeons with various experimental histories were maintained as in Experiments 1 and 2. The experimental chambers for all subjects were identical to the cubes used for R71 and R72 in Experiment 1.

### *Procedure*

As in Experiments 1 and 2, reinforcement occurred on VI 45-s and VI 90-s schedules on the left and right keys, respectively. Following food delivery on either schedule, all keys remained dark for an interval (the ITI). The duration of the ITI was varied across conditions. There were no other timeouts during the schedules of reinforcement. All other procedural details were as in the previous experiments. The ITI values in each condition are given in Table 3 in the order of presentation.



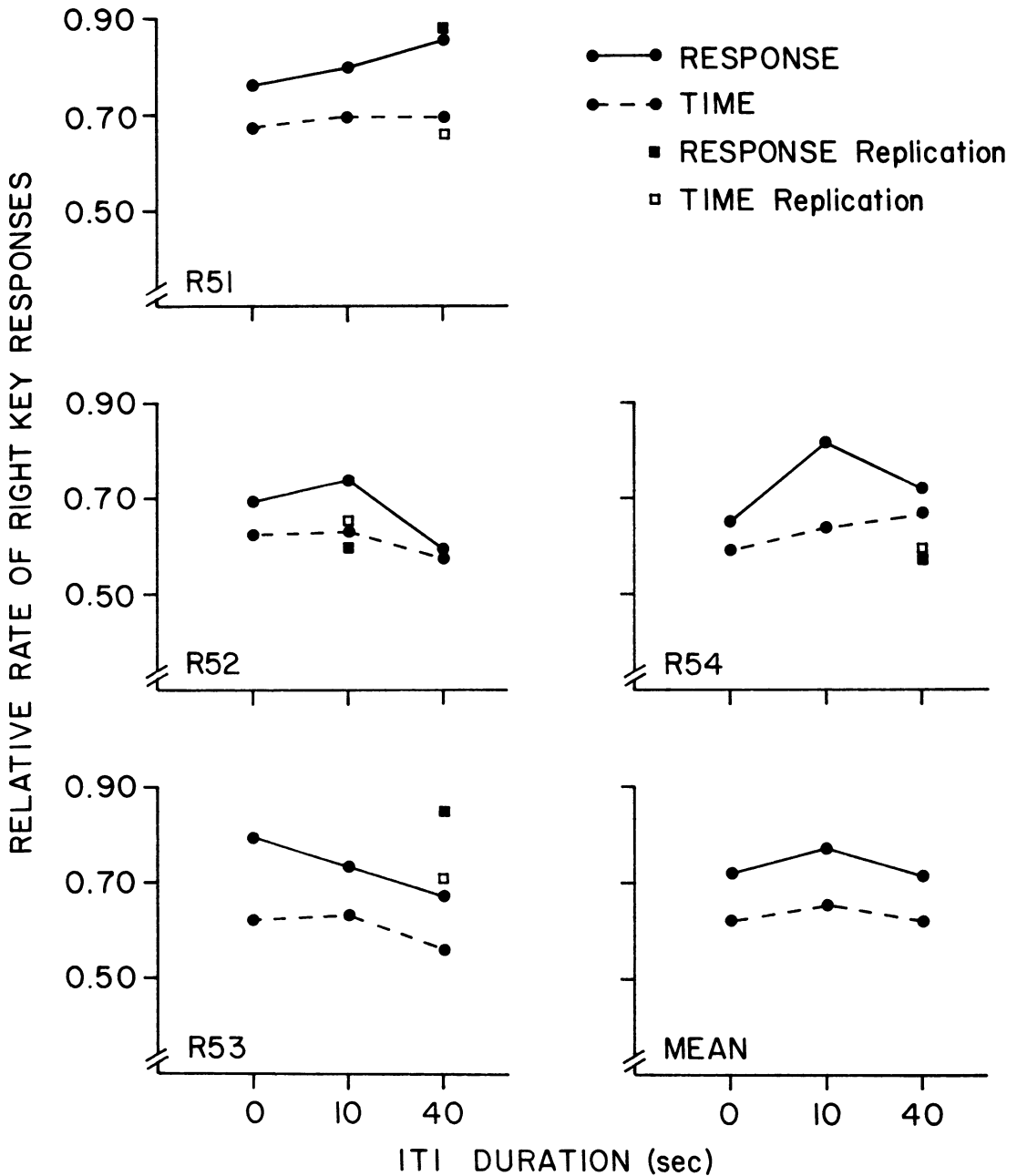


Fig. 3. Relative response rates and time allocation on the VI 45-s alternative (the right key) as a function of ITI duration in Experiment 3. For clarity of presentation, the data points are connected across the ordinal scale on the x axis.

### RESULTS

The data were averaged over the last nine sessions of each condition. No measured behavior varied systematically with the duration

of the ITI. Relative response rates and time allocation on the concurrent food schedules are plotted as a function of ITI duration in Figure 3. In general, time allocation proportions were less extreme than response proportions. On the

average, response proportions overmatched and time proportions undermatched the relative rates of reinforcement. With the exception of R51, both measures of choice in the replicated condition tended to differ substantially from the earlier determinations. The absolute response rates and time spent in the presence of each lighted side key, as well as the changeover rate in each condition, are also presented in Table 3. The rate of responding during the changeover ratio averaged 139 per minute with very few interruptions. The obtained rates of reinforcement approximated the programmed rates.

### DISCUSSION

Neither measure of preference varied systematically with the ITI and, therefore, preference did not vary with the overall rate of reinforcement in this procedure. Two features of this procedure are different from Experiments 1 and 2. One, the stimuli correlated with extinction were not specifically contingent on responses on either food schedule. Two, in the earlier procedures, timeouts occurred during situations correlated with food delivery. In Experiment 3, food was never delivered in the signaled period immediately after reinforcement. The latter distinction is more likely to be critical. There is evidence (e.g., Wagner, 1969) that periods of nonreinforcement that occur predictably (as in Experiment 3) are functionally different from timeouts that occur in a context correlated with reinforcement. This distinction is certainly consistent with the description of timeout as a punisher. In Experiment 3, the duration of predictable periods of extinction was varied without systematic variation in preference. Thus, the functional relation (unpredictable response-contingent timeouts in the context of food deliveries) that could be expected to enhance the aversiveness of timeout appears critical to the pattern of results obtained in Experiments 1 and 2. However, timeout does not appear to punish behavior, or at least function like shock, in these procedures.

### GENERAL DISCUSSION

The addition of equal frequencies and durations of response-contingent timeout from reinforcement to choice procedures did not suppress the response rate and did not increase

the level of preference. In fact, there is a slight but consistent decrease in relative response rates correlated with the addition of timeout contingencies. If it were possible to salvage a description of timeout as a punisher, the description would be at odds with the subtractive model of punishment suggested by de Villiers (1980) and Farley (1980). It may be possible to derive some support from the present results for models of punishment that rely on augmentation of competing responses (e.g., Deluty, 1976; Deluty & Church, 1978). The applicability of such models seems to depend on an account of the interaction with unmonitored responses and reinforcers. However, the generality of a competing response model of punishment is substantially limited by the failure to accommodate the results of de Villiers' (1980) and Farley's (1980) shock procedures, and it may be an inappropriate recourse here (cf. Dunham, 1972, 1978).

There were differences among the studies under discussion. Most notably, an explicit changeover response was required in the present procedures. Neither Farley (1980) nor de Villiers (1980) required an explicit changeover. Todorov (1977) varied the intensity of equal shocks added to concurrent VI 1-min VI 3-min food schedules; that is, used essentially the procedure later reported by de Villiers except that Todorov employed an explicit changeover requirement. Unfortunately, there was little evidence of control by the concurrent food schedules, and the results should be treated with some caution. However, relative response rates were most extreme (approximately matching relative reinforcement rate) at the highest shock intensity (10 mA). Thus, despite the changeover requirement, Todorov's results concur with those reported by de Villiers and are inconsistent with the pattern of results reported here.

The comparisons to the other manipulations of reinforcer density (Alsop & Elliffe, 1988; Logue & Chavarro, 1987) must be qualified. Both studies employed nonindependent schedules of reinforcement to ensure the programmed relative rates of reinforcement; the present procedures employed independent schedules. The difference in contingencies was not reflected in the distribution of reinforcers: Obtained relative rates of reinforcement deviated little if at all from programmed rates. Moreover, manipulation of the timeout con-

tingencies did not affect the relative rates of reinforcement (including timeouts) averaged over all events on the two alternatives. For example, as the frequency of equal timeouts was varied in Experiment 1, the frequency of timeout per reinforcer on the VI 90-s schedule was always double the frequency per reinforcer on the VI 45-s schedule. Thus, the relative overall rate of reinforcement on the VI 90-s alternative remained half that on the VI 45-s schedule. If the relative rate of reinforcement were the sole determinant of preference, neither the response nor the time measure would be expected to vary with the parameters of timeout in the present procedures.

The description of timeout in choice procedures is far from complete. Punishment effects may have been masked by the variance in reinforcement rate during manipulations of timeout frequency or duration in these experiments. Further investigation should include comparisons of timeouts and unsignaled periods of extinction, response-dependent and -independent timeout schedules, and conditions with equivalent absolute rates of reinforcement with and without timeouts. The results do extend the available evidence that preference on concurrent schedules of differing frequencies of reinforcement is determined in part by the overall rate of reinforcement (Alsop & Elliffe, 1988; Logue & Chavarro, 1987; cf. Fantino et al., 1972). This finding appears common to concurrent schedules of differing amounts (Alsop & Davison, 1988) and differing delays of reinforcement (Davison, 1988; Dunn & Fantino, 1982; Fantino, 1981). The results of Experiments 1 and 2 demonstrate that preference varies with the overall rate of reinforcement averaged over signaled periods of extinction and signaled periods of reinforcer availability. Experiment 3 suggests a limit on that generality: Preference did not vary systematically with the duration of an intertrial interval, a predictable signaled period of extinction.

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